

1 WALTER VIEGENER, citizen of Germany, whose residence and
2 post office addresses are Biekhofstrasse 26, 57439 Attendorn, Germany, has
3 invented certain new and useful improvements in a
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6

7 NON-DETACHABLE PRESS FIT ARRANGEMENT BETWEEN A
8 FITTING AND AN END PORTION OF A METAL PIPE
9

10

11

12 of which the following is a complete specification:

Patent 6,270,260

1 NON-DETACHABLE PRESS FIT ARRANGEMENT BETWEEN A
2 FITTING AND AN END PORTION OF A METAL PIPE

3
4 CROSS-REFERENCES TO RELATED APPLICATIONS
5

6 This application claims the priority of German Patent Application Serial
7 No. 297 21 760.7, filed December 10, 1997, the subject matter of which is
8 incorporated herein by reference.
9

10 BACKGROUND OF THE INVENTION
11

12 The present invention relates to a non-detachable, cold-formed press fit
13 arrangement between an end portion of a metal pipe in a socket of a fitting, with
14 the socket formed with an annular anchoring groove facing interiorly of the socket
15 for receiving a sealing ring.
16

17 In general, a press fit arrangement between the socket of a fitting and an
18 end portion of a metal pipe up to an inside diameter of 54 mm is realized by an
19 electrohydraulic press tool which is provided with a crimping bracket having two
20 jaws that bound a compression zone. These jaws are swingably mounted to
21 adapters which extend transversely to the longitudinal axis of the bracket. The
22 jaws grab around the socket of the fitting in the area of a bead for receiving the
23 sealing ring and on both sides of the bead. A force is applied immediately before,

1 on and behind the bead to realize a non-detachable joint. Through cold
2 formation of the bead, the sealing ring is pressed onto the pipe end while
3 indentations spaced about the circumference are formed before and behind the
4 bead for plastically deforming the pipe end in the area of the indentations.

5

6 When greater diameters of metal pipes are involved, the use of a crimping
7 bracket whose jaws are directly placed over a fitting is inadequate to effect a cold
8 forming operation of the fitting and the inserted end portion of the metal pipe. In
9 order to non-detachably bond pipes with an inside diameter of 70, 80 or 100 mm
10 through cold forming, the use of electrohydraulically operated tools is known
11 which are however bulky and difficult to handle. These tools are provided with a
12 wraparound ring which is placed over the socket of a fitting after inserting the end
13 portion of the metal pipe in the socket. By means of the wraparound ring, the
14 inwardly open bead, which receives the sealing ring, and the area of the socket
15 neighboring the bead together with the pipe portion located in this area are
16 commonly deformed in a triangular shaped manner, whereby the sides of the
17 triangle assume a curved configuration and the corners are rounded.

18

19 It is also known to provide the fitting with smooth ends and to produce the
20 bond between one end of the fitting and an end portion of the metal pipe by
21 utilizing a socket in which the end of the fitting and the end portion of the metal
22 pipe are inserted, and which is slotted in longitudinal direction. The width of the
23 slot can be decreased by means of locking screws so that the socket is pressed

1 onto the ends of the fitting and the metal pipe. A seal is placed in the socket for
2 circumscribing the ends of the fitting and the metal pipe.

4 SUMMARY OF THE INVENTION

6 It is an object of the present invention to provide an improved press fit
7 arrangement between a fitting and a metal pipe, obviating the afore-stated
8 drawbacks.

10 In particular, it is an object of the present invention to provide an improved
11 press fit arrangement for use with metal pipes of an inside diameter exceeding
12 54 mm, which realizes a round or substantially round cross-section of the socket
13 even in the crimped end state whereby the sealing forces and holding forces
14 about the entire circumference are the same or substantially the same.

16 These objects, and others which will become apparent hereinafter, are
17 attained in accordance with the present invention by providing a socket which is
18 formed with an annular anchoring groove facing inwardly for receiving a sealing
19 ring, and by securing at least one holding element to the socket and cold forming
20 the holding element together with the socket, with the holding element at least
21 partially penetrating the material of the end portion of the metal pipe to realize a
22 positive fit with the metal pipe.

1 According to one embodiment of the invention, the socket is formed
2 adjacent the anchoring groove for the sealing ring with an annular receiving
3 groove facing the interior space for receiving the holding element, whereby the
4 holding element is provided with projections spaced about the circumference of
5 the holding element and pointing towards the end portion of the metal pipe, or
6 with a circumferential cutting edge extending towards the end portion of the metal
7 pipe. When cold forming the socket of the fitting, the projections or the cutting
8 edge realize the positive fit between the holding element and the end portion of
9 the metal pipe.

10

11 The holding element may be a ring formed with an axial slot, with the
12 ring-shaped holding element having a cross section in the form of a vertex of a
13 triangle (or pointed roof configuration), or a curved cross section or a polygonal
14 cross section. It is also possible to configure the receiving groove with a conical
15 base, whereby the holding element has a cross sectional contour which
16 complements the conical base of the receiving groove and includes a free edge
17 of small diameter for penetration into the end portion of the metal pipe after
18 radially compressing the socket.

19

20 According to another feature of the present invention, the socket of the
21 fitting may also be provided adjacent the entry opening for the metal pipe with an
22 outwardly directed annular anchoring groove for accommodating an anchoring
23 flange of a sleeve-like holding element.

1 According to still another feature of the present invention, the anchoring
2 groove is formed in a bead of the socket, with the holding element being a
3 stepped sleeve having a first portion of smaller diameter and a second portion of
4 greater diameter, with the second portion overlapping the bead of the socket, and
5 with the first portion surrounding the metal pipe. After crimping operation, the
6 holding element matches the outer contour of the socket, with the first portion of
7 the stepped sleeve denting the material of the metal pipe.

8

9 Suitably, the socket of the fitting has an outer peripheral surface provided
10 with an engagement member in form of a circumferential groove, lobes, ribs or
11 circumferential fins for attachment of a press tool, preferably a wraparound chain.

12

13 According to yet another feature of the present invention, the holding
14 element has a hardness exceeding a hardness of the metal pipe. Preferably, the
15 holding element is made of special steel.

16

17 A press fit arrangement in accordance with the present invention realizes
18 a positive fit between the holding element, which is secured to the socket of the
19 fitting, and the metal pipe by providing the holding element with spikes, teeth,
20 crawls or cutting edges which dig into the material of the end portion of the metal
21 pipe during crimping operation. It is also possible to provide the holding element
22 in the form of an axially slotted sleeve which surrounds the metal pipe and
23 partially dents the material of the metal pipe.

BRIEF DESCRIPTION OF THE DRAWING

The above and other objects, features and advantages of the present invention will now be described in more detail with reference to the accompanying drawing in which:

FIG. 1 is a longitudinal section of a press fit arrangement according to the present invention for joining a fitting and an end portion of a metal pipe;

FIG. 2 is a longitudinal section of the press fit arrangement, showing the end portion of the metal pipe inserted in a socket of the fitting and a press tool attached to the socket for carrying out a crimping operation;

FIG. 3 is a longitudinal section of the press fit arrangement after realizing a non-detachable positive fit between the fitting and the end portion of the metal pipe;

FIGS. 4 to 6 are enlarged sectional views of various stages for realizing a non-detachable positive connection between the fitting and the metal pipe;

FIG. 7 is a longitudinal section of a press fit arrangement

1 according to the present invention, showing a variation of the holding element
2 and associated receiving groove in the socket, for realizing the non-detachable
3 positive connection between the fitting and the metal pipe;

4

5 FIGS. 8 to 11 are longitudinal sections of press fit arrangements
6 according to the present invention, showing further variations of the type of
7 holding element shown in FIG. 7;

8

9 FIG. 12 is a longitudinal section of a press fit arrangement
10 according to the present invention, showing a modified type of holding element
11 and associated receiving groove in the socket, with the holding element
12 projecting outward beyond the area of the socket; and

13

14 FIGS. 13 to 18 are longitudinal sections of press fit arrangements
15 according to the present invention, showing further variations of the type of
16 holding element shown in FIG. 12.

17

18 DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

19

20 Throughout all the Figures, same or corresponding elements are generally
21 indicated by same reference numerals.

22

23 Turning now to the drawing, and in particular to FIG. 1, there is shown a

1 longitudinal section of a press fit arrangement according to the present invention
2 for joining a fitting, generally designated by reference numeral 1 and an end
3 portion 4 of a metal pipe. The fitting 1 includes a spigot 2, which is provided with
4 an external thread for attachment e.g. to another pipe (not shown), and a
5 socket 3 for receiving the pipe end 4. The socket 3 has an inside diameter which
6 corresponds to the outside diameter of the pipe end 4 and is formed interiorly
7 with a circumferential annular stop surface 5 for interaction with an end face 6 of
8 the pipe end 4 to thereby restrict the entry path of the pipe end 4.

9

10 The socket 3 defines an interior space 7 and is provided with an anchoring
11 groove 8 which is open towards the interior space 7 for accommodating a sealing
12 ring 9. Positioned near the entry opening for the pipe end 4 at an axial distance
13 to the sealing ring 9, the socket 3 is further provided with a receiving groove 11
14 for securement of a holding element 10. In the exemplified embodiment of FIG. 1,
15 the holding element 10 is ring-shaped and slotted in longitudinal direction to form
16 a plurality of projections 12 which are spaced about the circumference of the
17 holding element 10 and point in the direction of the pipe end 4. Suitably, the
18 holding element 10 is situated between the sealing ring 9 and the free end of the
19 fitting 1, thereby ensuring that the holding element is prevented from contacting
20 liquid transported under pressure in the metal pipe.

21

22 In the non-limiting example of FIG. 1, the sealing ring 9 is formed by an
23 O ring of relatively small cross section; However, it is certainly within the scope of

1 the present invention to provide the sealing ring 9 as lip seal or as matched
2 annular formed body.

3

4 The holding element 10 is positively fitted or resiliently installed in the
5 receiving groove 11, whereby a spring-mounted installation of the sealing ring 9
6 enables a compensation of tolerance deviations between interacting
7 components.

8

9 After inserting the pipe end 4 through the entry opening of the socket 3
10 until the end face 6 of the socket 3 impacts the stop surface 5, a press tool 13,
11 shown only schematically in FIG. 2, is attached from outside to the socket 3 for
12 subsequent execution of the crimping operation. Suitably, the socket 3 of the
13 fitting 1 is formed about its outer peripheral surface with a circumferential groove
14 21 for receiving a complementary rib 13' of the press tool 13, preferably a
15 wraparound chain of the press tool 13. Persons skilled in the art will understand
16 that instead of the described circumferential groove, the socket 3 may also be
17 formed with lobes, ribs or circumferential ridges for cooperation with
18 complementary components on the press tool 13.

19

20 As shown in particular in FIG. 4, the projections 12 of the holding
21 element 10 are pointed toward the outer surface area of the pipe end 4. During
22 radial crimping operation, liquid flowing through the metal pipe 4 is kept away
23 from the holding element 10 as a result of the interference fit of the sealing ring 9

365217 "PATENT"

1 upon the pipe end 4 whereas the projections 12 of the holding element 10 dig
2 into the material of the pipe end 4, as shown in FIG. 3 and in particular in FIG. 5.
3 Thus, the socket 3 of the fitting 1 is positively attached to the pipe end 4. After
4 removing the press tool 13, a slight recoil of the cold formed fitting parts is
5 encountered; However, during the slight recoil, the projections 12 of the holding
6 element 10 remain entrenched in the material of the pipe end 4. The final state of
7 the crimping operation is shown in FIG. 6.

8

9 By radially crimping the socket 3 of the fitting 1 with the inserted pipe
10 end 4 by means of the press tool 13, a round cross section of the socket 3 is
11 substantially retained while the particular configuration and arrangement of the
12 holding element 10 results in same or substantially same holding forces around
13 the circumference of the socket 3. The same is true for the sealing forces which
14 are applied between the sealing element 9 and the pipe end 4 as a result of the
15 radial deformation of the anchoring groove 8 during crimping operation.

16

17 Persons skilled in the art will understand that even though the press fit
18 arrangement shown in the drawings uses only a single holding element 10, it is
19 certainly within the scope of the invention to secure several holding elements in
20 the receiving groove 11.

21

22 In describing the following Figures, like parts of the press fit arrangement,
23 in particular the holding element 10 and the associated receiving groove 11, will

1 be identified by corresponding reference numerals followed by a distinguishing
2 lower case character.

3

4 Turning now to FIG. 7, there is shown a longitudinal section of a modified
5 press fit arrangement 1 which includes a holding element 10a and associated
6 receiving groove 11a in the socket 3 for realizing the non-detachable positive
7 connection between the fitting 1 and the pipe end 4. The holding element 10a is
8 ring-shaped and slotted in longitudinal direction, and the receiving groove 11a is
9 formed with a conical base 14, whereby the cross-sectional contour of the
10 holding element 10a is matched to the contour of the base 14. The holding
11 element 10a thus has the shape of a truncated cone, with the free edge on the
12 end of smaller inside diameter penetrating the material of the pipe end 4 after
13 radial crimping operation.

14

15 In the embodiment of the press fit arrangement of FIG. 8, the holding
16 element 10b has a cross section in the form of a vertex of a triangle (i.e. pointed
17 roof configuration). At radial crimping operation of the fitting 1 and the pipe end 4,
18 the free edges 18 of the holding element 10b penetrate the material of the pipe
19 end 4. In FIG. 9, the positive fit during crimping operation is realized in the same
20 manner by the free edges 18 of the holding element 10c which however has an
21 arched configuration. In FIG. 10, the holding element 10d is of polygonal
22 configuration, with the free edges 18 penetrating the material of the pipe end 4.

23

1 FIG. 11 shows a press fit arrangement 1 in which the holding element 10e
2 is of annular configuration and slotted in longitudinal direction. The holding
3 element 10e is arranged in the receiving groove 11e of the socket 3 and is
4 provided on its side distant to the sealing ring 9 with a conical surface 23. The
5 conical surface 23 interacts with an opposite complementary conical surface 24
6 on the inside of the socket 3 of the fitting 1 so that the projections 12e in the form
7 of teeth or the like on the side proximal to the sealing ring 9 penetrate the
8 material of the pipe end 4 when the socket 3 and the pipe end 4 are pressed
9 together. As stated above, it is certainly possible to use instead of a ring-shaped
10 holding element, several holding elements in the form of ring segments which are
11 arranged in the receiving groove 11e.

12
13 Turning now to FIG. 12, there is shown a longitudinal section of a further
14 variation of a press fit arrangement 1 according to the present invention, in which
15 the holding element 10f is of sleeve like configuration and slotted in axial
16 direction. The socket 3 is formed with an annular receiving groove 11f which is
17 open towards the pipe end 4 to bound with the outer peripheral surface of the
18 pipe end 4 an annular gap 29 at the end face of the fitting 1 for passage of the
19 holding element 10f and securement of an anchoring flange 27 inside the
20 receiving groove 11f, with the anchoring flange 27 being formed in one-piece with
21 the holding element 10f. The sleeve-like holding element 10 thus projects
22 outward beyond the area of the socket 3 and surrounds the pipe end 4. When
23 operating the press tool 13, a portion 10'f of the holding element 10f dents

1 the material of the pipe end 4 during crimping operation, and the sealing ring 9 is
2 squeezed between the socket 3 and the outer peripheral surface of the pipe
3 end 4, resulting in a positive fit between the holding element 10f and the pipe
4 end 4, as shown in FIG. 13.

5

6 In the embodiment of the press fit arrangement 1 according to FIG. 14, the
7 socket 3 is surrounded by a holding element 10g which has a sleeve-like
8 configuration and is slotted in longitudinal direction. The holding element 10g is
9 also provided with an annular anchoring flange 32 which engages in the
10 receiving groove 11g. On its side distant to the anchoring flange 32 and facing
11 the pipe end 4, the holding element 10g is provided with teeth 31 which dig into
12 the material of the pipe end 4 when compressing the socket 3 and the holding
13 element 10g onto the pipe end 4, to thereby realize a positive fit between the
14 holding element 10g and the pipe end 4.

15

16 FIG. 15 shows a variation of the press fit arrangement 1 in which the
17 holding element 10h is a sleeve slotted in longitudinal direction and formed in
18 one piece with an inwardly directed flange ring 36 for engagement in an
19 outwardly open receiving groove 37 of the socket 3 of the fitting 1. The holding
20 element 10h is formed with inner teeth 31 which penetrate the material of the
21 pipe end 4 during crimping operation for realizing a positive fit.

22

23 FIG. 16 shows a holding element 10i which unlike the holding element 10h

1 is not serrated but is provided with a smooth sleeve to surround the pipe end 4,
2 and is slotted in longitudinal direction. A crimping operation of the holding
3 element 10i and the socket 3 with the pipe end 4 results in a common permanent
4 deformation between a sleeve portion 10'i of the holding element 10i and the
5 pipe end 4.

6

7 FIG. 17 shows a holding element 10k which is formed as stepped sleeve
8 having an inward portion 40 of greater inside diameter and an outward portion 42
9 of smaller inside diameter. The portion 40 overlaps a bead 41 which forms
10 interiorly the anchoring groove 8 for the sealing ring 9, whereas portion 42
11 surrounds the pipe end 4. After crimping the sleeve-like holding element 10k,
12 which preferably is slotted in axial direction, with the socket 3 of the fitting 1 and
13 the pipe end 4, the holding element 10k follows the contour of the socket 3, while
14 a portion 10'k of the holding element 10k is compressed into the pipe end 4 to
15 commonly deform these parts, as shown in FIG. 18.

16

17 Preferably, the holding element 10 has a hardness which exceeds the
18 hardness of the metal pipe. Suitably, the holding element 10 is made of special
19 steel.

20

21 Although in the preceding examples of the press fit arrangement, the
22 holding element is generally shown at a location between the sealing ring 9 and
23 the free end of the fitting 1 or also projecting beyond the free end of the fitting 1,

1 it is also possible to position the holding element in a region between the stop
2 surface 5 and the sealing ring 9. In this case, the holding element comes into
3 contact with the liquid transported in the metal pipe so that the holding element
4 should be made of corrosion-resistant material.

5

6 While the invention has been illustrated and described as embodied in a
7 non-detachable press fit arrangement between a fitting and an end portion of a
8 metal pipe, it is not intended to be limited to the details shown since various
9 modifications and structural changes may be made without departing in any way
10 from the spirit of the present invention.

11

12 What is claimed as new and desired to be protected by Letters Patent is
13 set forth in the appended claims: